

## Sleeve and wedge parenchyma-sparing bronchial resections in low-grade neoplasms of the bronchial airway

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**Objective:** Sleeve and wedge bronchial resections without parenchymal resection may represent a surgical option in selected cases of low-grade neoplasms of the airway. We reviewed our experience analyzing the indications, the operative technique, and the results of such operations.

**Methods:** From 1980 to 2006, we performed 248 bronchoplastic procedures, and 26 of those were bronchoplastic procedures without parenchymal resection for low-grade neoplasms of the airway. There were 17 men and 9 women with a mean age of 49.4 years (range 19-74 years). All patients underwent a preoperative bronchoscopic study, which gave indication for such a procedure, and an intraoperative bronchoscopic examination confirming the feasibility and the good quality of the bronchial suture. The bronchial resection involved the trachea and the carina (n = 5), the main bronchi (n = 7), the intermediate bronchus (n = 2), the bronchial corner (n = 6), and the lobar bronchus (n = 6).

**Results:** The resection margins were always tumor free. There was no operative mortality. The mean hospital stay was 6.7 days (range 4–16 days). One minimal dehiscence and no stenosis of the anastomosis were observed. In 1 case we experienced a granulation that required an endoscopic treatment. The histologic type was carcinoid (n = 18), mucoepidermoid (n = 2), adenoid cystic (n = 1), chondroma (n = 2), hamartoma (n = 1), melanoma endobronchial metastasis (n = 1), and glomic tumor (n = 1). The mean follow-up was 134 months and no local relapse occurred.

**Conclusion:** Bronchoplastic procedures without resection of the lung parenchyma are a suitable and fascinating technique for selected cases of low-grade endobronchial neoplasms.

Low-grade neoplasms of the bronchial airway frequently involve the lumen of major bronchi, sometimes have a well-defined plant basis, and therefore allow a less invasive procedure, which represents a fascinating challenge for the surgeon.<sup>1</sup>

Several articles support bronchoplastic procedures as the treatment of choice for low-grade tumors of the bronchial airway.<sup>2-5</sup> Parenchyma-sparing procedures achieved functional and oncologic results.<sup>6-11</sup> Sleeve or wedge bronchial resections without parenchyma resection have been described in a few case

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**Abbreviations and Acronyms**

CT = computed tomography

reports; unfortunately, such procedures have still not been validated.<sup>12,13</sup> We review our experience with bronchoplastic procedures, dwelling on the sleeve and wedge parenchyma-sparing bronchial resections in low-grade neoplasms of the bronchial airway, to analyze the indications, the operative technique, and the results of such operations.

**Patients and Methods**

From 1980 to 2006, more than 9000 lung resections for lung cancer and low-grade neoplasms of the airway have been performed in our division. In the same period, 26 of 248 bronchoplastic procedures were performed without parenchymal resection. Data collection and follow-up were performed by reviewing medical charts and through telephone contact or patient examination.

Our sample consisted of 17 men and 9 women with a mean age of 49.4 years (range 19–74 years). The histologic diagnosis was confirmed by review of microscopic sections by a dedicated pathologist (G. F.). All patients underwent a preoperative workup including a physical examination, a chest radiograph and computed tomographic (CT) scan, an abdominal ultrasound, and a bronchoscopic examination with biopsy. The preoperative bronchoscopic examination suggested the possibility of a bronchoplastic procedure, and an intraoperative bronchoscopic examination confirmed the feasibility and the good quality of the bronchial suture. In the last cases, a CT with 3-dimensional reconstruction (virtual endoscopy) was performed. Whenever the tumor was bleeding or the bronchial involvement of the tumor was not clear, preoperative laser treatment was performed through a rigid endoscope.

Concerning the operative technique, after a double-lumen endotracheal intubation, a posterolateral thoracotomy was always performed. The involved bronchus was carefully dissected and the proximal and distal points of transection were determined under bronchoscopic guidance. Full-thickness traction sutures of polyglyconate (Maxon 2-0; Tyco Healthcare, Mansfield, Mass) were placed proximally and distally in the bronchus to reduce tension during the suture. Wedge bronchial resections were sutured with single stitches of polyglyconate 4-0 (Maxon); sleeve bronchial resections were performed with a continuous suture in the membranous wall and single stitches in the cartilaginous part. We never made any attempt to tailor either bronchial ends for size discrepancy so that some telescoping anastomoses resulted.

Once the suture was completed, we filled the pleural cavity with saline solution, re-expanded the lung, and checked for air leaks. Bronchoscopic examination confirmed the patency and adequacy of the suture or anastomosis. The bronchial suture was always wrapped with either pedicled pericardial fat or pleura to prevent a bronchovascular fistula. In a few cases, fibrin glue was applied to the suture. In all the cases, the inferior pulmonary ligament was dissected to release the bronchial

suture and avoid any tension. Hilar and peribronchial lymph nodes were always removed, and a systematic sampling of the mediastinal nodes was performed. All patients underwent a strict radiologic and endoscopic follow-up: a chest CT and a bronchoscopic examination were performed every 6 months for the first 2 years and then on an annual basis.

**Results**

A preoperative bronchoscopic examination was performed in all the cases but yielded a histologic diagnosis in only 17. In case of the presence of a carcinoid, we usually suggest an OctreoScan examination (Mallinkrodt, Inc, Hazelwood, Mo) (Figure 1) to detect systemic or lymph nodal metastases.

All procedures were carried out preoperatively; unfortunately, in 9 patients a parenchyma-sparing procedure was not possible and a lobectomy or sleeve lobectomy had to be performed. A frozen section of the resection margins and suspected hilar lymph nodes was always forwarded. In case of positivity of the resection margins or hilar lymph nodes, we always proceeded with a more extensive resection. In the present series, the resection margins, as well as the hilar lymph nodes, were always tumor free.

The bronchial resection (Figure 2) involved the trachea and the carina ( $n = 5$ ), the main bronchi ( $n = 7$ ), the intermediate bronchus ( $n = 2$ ), the bronchial corner ( $n = 6$ ), and the lobar bronchus ( $n = 6$ ). Twelve patients underwent a wedge bronchial resection and 14, a sleeve resection.

Our mortality rate was nil. The mean hospital stay was 6.7 days (range 4–16 days). The mean number of postoperative bronchoscopic examinations for bronchial toilette and control of the bronchial suture was 2.6 (range 2–4).

As regards postoperative morbidity, minimal dehiscence occurred in 1 patient. No instance of stenosis of the anastomosis occurred. Just 1 patient reported a granulation that required an endoscopic treatment. The histologic types were carcinoid ( $n = 18$ ), mucoepidermoid ( $n = 2$ ), adenoid cystic ( $n = 1$ ), chondroma ( $n = 2$ ), hamartoma ( $n = 1$ ), melanoma endobronchial metastasis ( $n = 1$ ), and glomic tumor ( $n = 1$ ). With a mean follow-up of 134 months, there was no local relapse. All of the patients except for the patient with melanoma endobronchial metastasis are alive and well.

**Conclusions**

Since the publication of reports by Price-Thomas<sup>2</sup> and Paulson and Shaw<sup>3</sup> about 50 years ago, the use of bronchoplastic procedures for both benign and malignant tumors has progressively increased.

Nowadays these procedures are well established for anatomically suited lesions, and it is possible to preserve lung

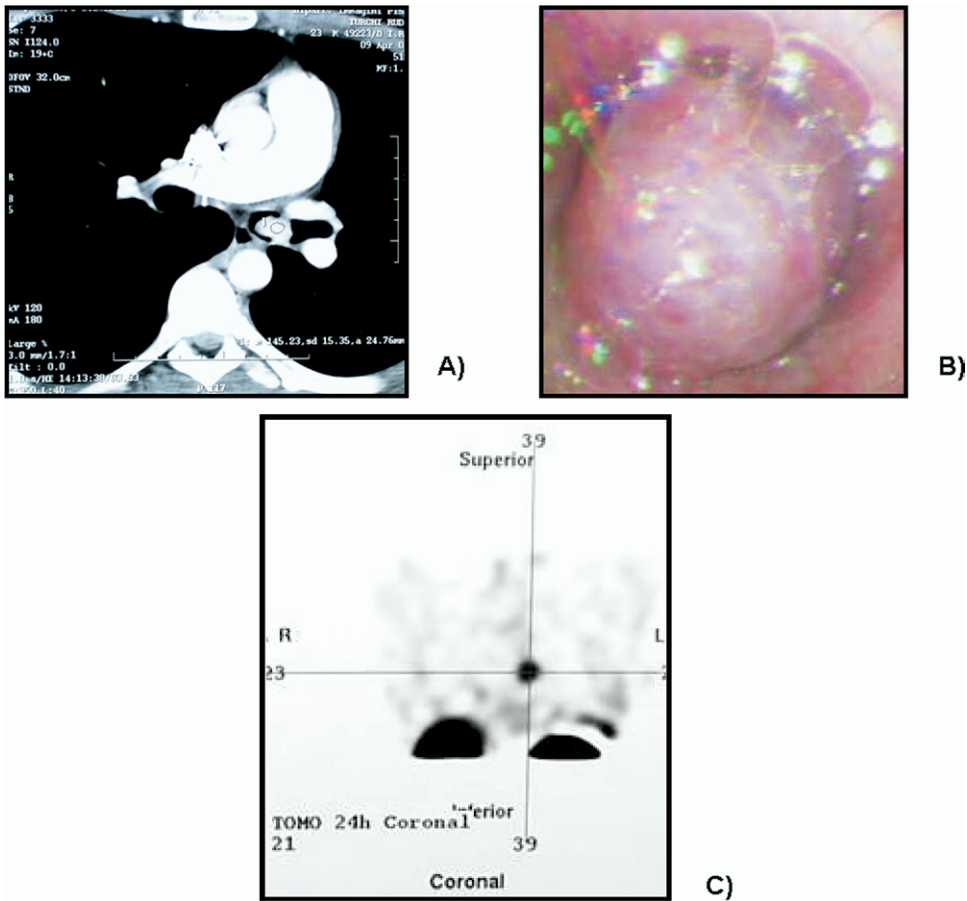


Figure 1. CT (A), endoscopic view (B), and OctreoScan (C) of a 23-year-old man with a carcinoid of the left main bronchus. R, Right; L, left; A, anterior; P, posterior.

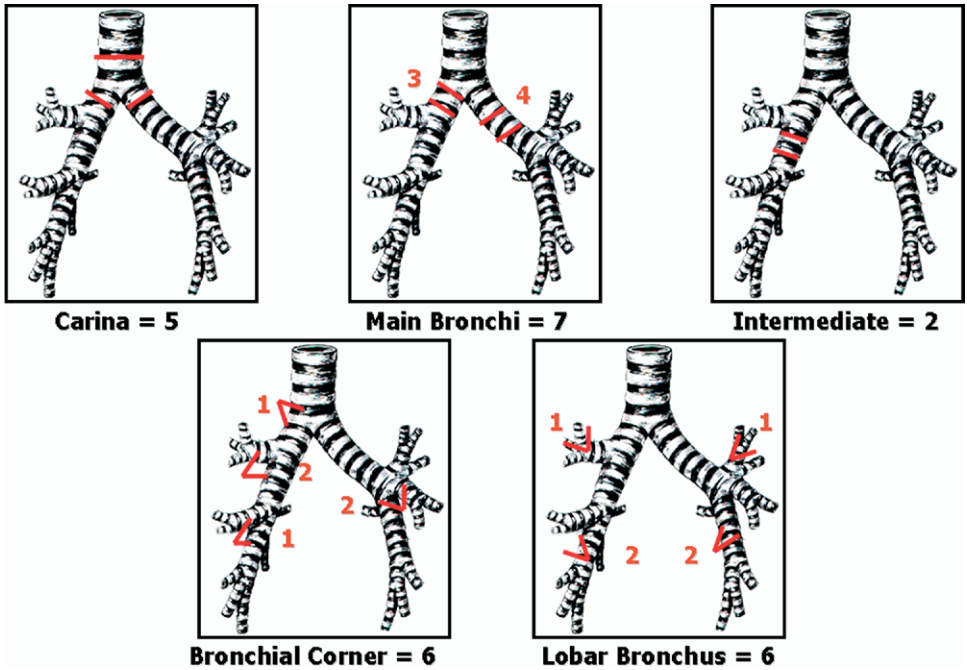
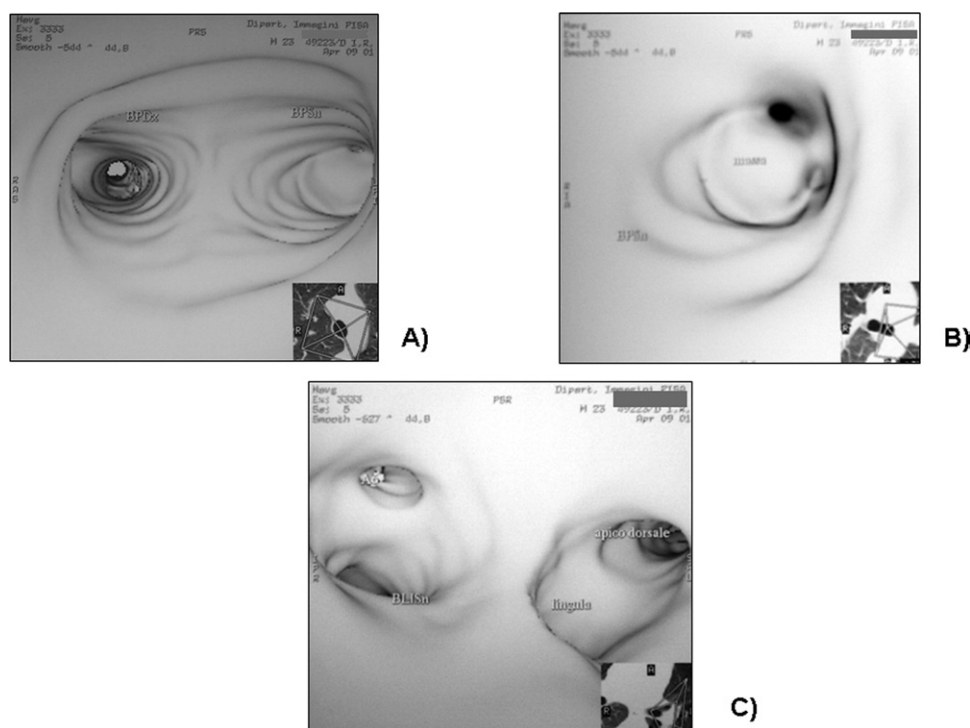


Figure 2. Sites of bronchoplasties.



**Figure 3. Virtual endoscopy showing a tumor of the left main bronchus (A), the base of the implant (B), and the lobar bronchi peripheral to the lesion (C).**

function and provide oncologic results comparable with more extensive resections.<sup>1,5,6,9</sup> Benign and low-grade malignant tumors of the bronchial airway, whenever occurring with specific characteristics, may be eligible for sleeve and wedge parenchyma-sparing bronchial resections.

To perform a sleeve or wedge bronchotomy without parenchymal resection, we considered the following points:

- A benign or low-grade malignant bronchial lesion without extrabronchial spread
- A small basis of implant of the lesion and a normal bronchial tree at its periphery
- Absence of hilar or mediastinal nodal metastasis

Patients with these characteristics require only minimal clear margins. For this reason, they can be managed with bronchial resections such as the wedge bronchial resection, in which the resection cannot be extended.<sup>1</sup> For this reason, an intraoperative bronchoscopic guide is a necessary tool to cut the bronchial wall adequately close to the lesion.

Most of the lesions were obstructive, and postoperative therapeutic aspiration bronchoscopy as well as chest physiotherapy were of paramount importance to avoid infective complications.<sup>10,11,14,15</sup>

To solve the problem of obstructive pneumonia and to clarify the real margins of the lesion, some authors em-

phasize the role of laser and/or coring out with the rigid bronchoscope before the definitive surgical treatment.<sup>16</sup> As concerns the anatomic definition of the lesion and the remaining bronchial tree, in recent years we used CT virtual endoscopy with 3-dimensional reconstruction (Figure 3). It proved to be useful for the assessment of the bronchial tree peripheral to the tumor, providing useful information about the length of the involved bronchial tree and the status of the bronchial wall beyond the tumor, whenever it was not superable by the endoscope. Bronchoscopic treatment of intraluminal benign and low-grade neoplasm has also been proposed in a highly selected group of patients. A prospective pilot study,<sup>17</sup> with a short median follow-up (29 months), showed that bronchoscopic treatment was not effective in 5 of 19 intraluminal typical bronchial carcinoids, with 1 case of severe cicatricial stenosis.

Moreover, the authors declared that they had some difficulties in treating intraluminal bronchial carcinoids extending to the segmental bronchi, particularly when the tumor was located in the left or right upper lobes. We always preferred to perform a sleeve bronchial resection whenever it was anatomically suitable. In 6 cases we also performed a wedge bronchial resection after the origin of the lobar bronchi, and in 2 cases the tumor was located in the upper lobes (Figure 4). Particularly in those locations, the resection margins are near the tumor and careful selection of the patients





**Figure 4.** Surgical field in a chondroma of the left upper lobar bronchus. The scissure is completely opened and the lingular artery branch (A), the first artery branch for the culmen (B), and the culmen bronchus (C) is sutured with the wedge bronchotomy.

represents the key for this kind of bronchoplastic procedures. Apart from the greater radicality of the surgical treatment in comparison with the endoscopic one, we can perform hilar and mediastinal lymph node sampling only with surgical treatment, and we also know that small low-grade neoplasms can have lymph node metastases.

Our follow-up is long enough to evaluate the results in terms of postoperative complications and incidence of local relapse. The hospital stay, as well as the morbidity rate, was good, and we did not experience any major complications. We did not observe any bronchial stenosis, and a case of granuloma on the bronchial suture was easily treated by Nd:YAG laser coagulation.

There was no incidence of local relapse, confirming that this kind of bronchoplastic procedure is adequate for intraluminal low-grade neoplasms of the bronchial airway inasmuch as the preservation of normal lung tissue represents one of our primary goals.<sup>1</sup>

In conclusion, bronchoplastic procedures without resection of the lung parenchyma are an adequate and fascinating technique for selected cases of low-grade endobronchial neoplasms.

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